Nanostructured Conformal Antenna for Biomedical Applications

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ABSTRACT

Graphene Nanoribbons (GNRs), a 2-D material mono atomic layer of carbon atoms ordered in a honeycomb structure, have emerged as a potential candidate for next generation electronics. GNRs posse band gaps that are tuned by changing the width of nano ribbons, thus transform semiconductor to semimetal as the width of the ribbon changes. Graphene allows the realization of planar structures. Its excellent conductivity and highest carrier mobility at room temperature make it an ideal candidate for fabrication of nano-scale patch antenna and low power device applications. The principal objective of our research is to develop, model and prototype a nano-structured flexible patch antenna and nano-scale spiral antennas for biomedical applications.

INTRODUCTION

For years advancement in Nanostructured and nano-scale antenna design is hindered due to unavailability of economical fabrication processes for realization of structures with suitable electrical properties. Several techniques such as lithography with photons, particles, and scanning probes, self-assembly, template deposition, conductive Ink, and nano printing have been used to achieve various level of integration and success. With the advancement in imprint lithography technology realization of such structure have become more economical. Nanotechnology has been used in sensors and sensors related technology. Nanotechnology and nano-particles based sensors is a thriving research area in medical science. Carbon Nano Tubes and nano wires based technology has also been used in radio-frequency and microwave applications.

PREVIOUS WORK

Principal requirements for a conformable antenna are low profile and small size, ability to minimize the radiation absorption by the human body and Reasonable gain. Microstrip patch antennas (MPAs) appear to be more suitable for wearable applications. We have simulated several low profile conformal antenna that can be used for remote health monitoring applications. Figure 1 below shows simulated designs and dimensions of antenna.

Fig. 1 nanostructure conformal patch antenna

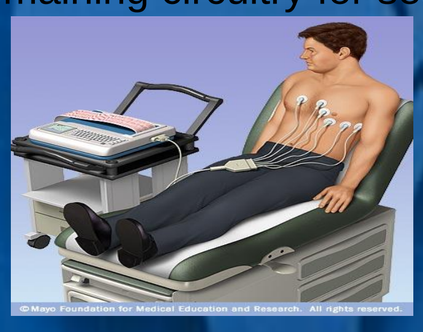
Patch		Substrate	
L (mm)	40.49	h (mm)	1.57
W (mm)	40.49	εr	2.2

TABLE 1: Dimension of proposed patch antenna

LOW PROFILE TRANMITTER & ANTENNA DESIGN

Goal:

- Detecting Vital Signs with Wearable Wireless Sensor.
- Wearable monitoring systems can provide continuous physiological data.
- Antennas are required to be compact, low-weight, conformal, high efficiency and compatible with the remaining circuitry for seamless integration.



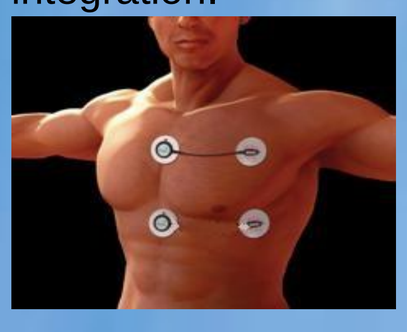


Fig. 2 Wired and Wireless ECG Monitor

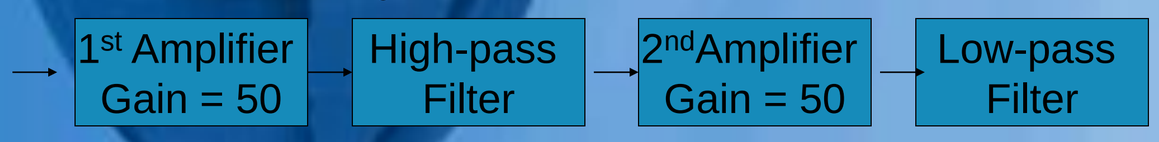


Fig. 3 ECG Signal Processing Block Diagram

NANO-SCALE ANTENNA DESIGN

Applications of nanoscale antennas are in the field of power harvesting, biosensors and medicine. Most of the research efforts are geared toward using nanoparticles for targeted drugs delivery. We focus on designing and fabricating nano-antenna using imprint lithography process, these antennas can use any well known techniques such as dendrimer molecules or bond to cancerous cells.

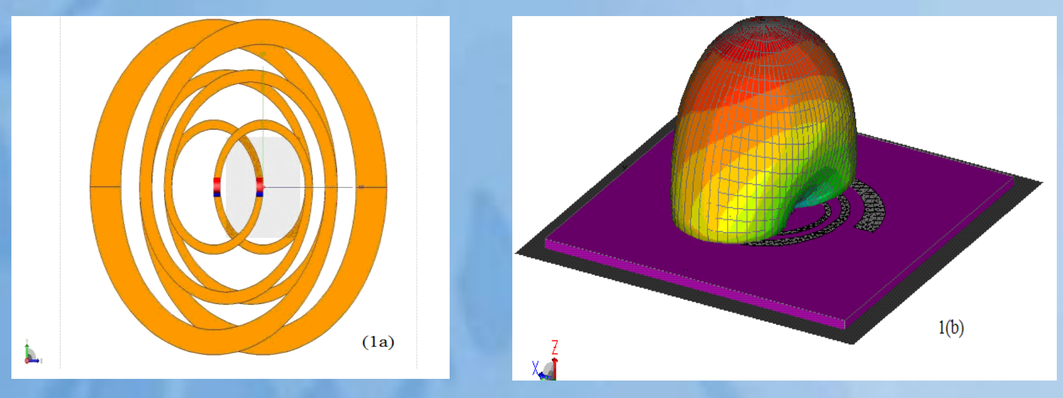


Fig. 4 210 x 240 nm Spiral Antenna Design

Milestones and Research Activities:

Phase 1: Antenna fabrication and characterization:

- During the first phase of the project 210nm X 240nm antenna will fabricated.
- Investigation of properties of nano-structured antenna and its characteristics in nano regime.
- Substrate and interconnect technologies will also be investigated in this stage.
- Investigation of Spiral spacing and mutual coupling effects in nanoscale design.

Phase 2: Biomaterial Investigation

- Study of electrical properties of biocompatible materials such as liposomes, Carbon Nano Tubes (CNT) polymer-based nano- materials for antenna applications.
- The study of the interactions between cells and antenna material.
- Study of how to attach the antenna to the dendrimer or how to make a bond with cancerous cell.

APPLICATIONS

Applications of such antennas are in the field of power harvesting, biosensors and medicine. Most of the research efforts are geared toward using nanoparticle for targeted drugs delivery. We focus on designing and fabricating nano-antenna using imprint lithography process, these antennas can use any well known techniques such as dendrimer molecules, graphene oxide anticancer drug carrier and bind to cancerous cells.

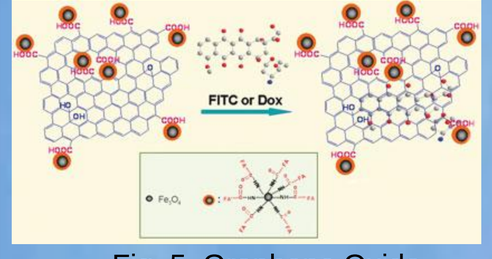


Fig. 5. Graphene Oxide Anticancer Drug Carrier

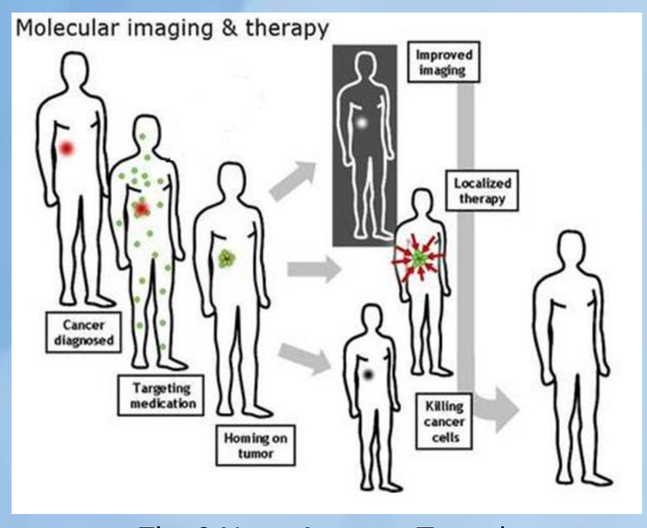


Fig. 6 Nano Antenna Targeting

CONCLUSION

Several conformable and nanoscale antennas were simulated for biomedical applications. Nanoscale antenna antennas provide tremendous potential for the realization of novel sensors and devices for biomedical applications.